PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Peter HAWKINS et al. | Group Art Unit: 1641

Application No.: 09/816,225 | Examiner: P. Do

Filed: March 26, 2001 | Docket No.: 109068

For: PARA MAGNETIC PARTICLE DETECTION

REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In reply to the September 21, 2004 Office Action, reconsideration of the rejection is respectfully requested in light of the following remarks.

Claims 9-13 are pending in this application. The Office Action, on pages 2-4, rejects claims 9-13 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,046,585 to Simmonds. This rejection is respectfully traversed.

Simmonds discloses an apparatus for quantitatively measuring groups of magnetic particles when they are excited in a magnetic field (Abstract). The magnetic particles are caused to oscillate at the excitation frequency to create their own magnetic fields, and these fields are then inductively coupled to sensing coils fabricated in a gradiometer configuration in order that the amplitude of the resulting oscillation of the magnetic moment of the particles may be inductively sensed (Abstract and col. 1, lines 10-15). As such, Simmonds teaches a system that performs a measurement of induced voltage (current) in two sensing coils (col. 7, lines 4-24). In order that precise measurements are available from the apparatus disclosed in

Simmonds, magnetic particle laden samples must be accurately deposited in spots, or in another clearly-defined arrangement on a disk, which is then moved in a gap between the pole pieces of a circular electromagnet that is energized with an AC magnetic field (Figs. 3 and 4, and col. 6, lines 36-54). Sensing coils are wound in opposite directions and connected in series (gradiometer configuration) so that current induced in one coil by the AC field exactly cancels out the current induced in the other such that no current would be detected by a difference amplifier (element 61 in Fig. 4) when there is no sample present in the gap, thus establishing a reference signal (col. 6, line 66 – col. 7, line 2).

When a sample enters the gap it first moves over one sensing coil which because of the presence of paramagnetic material in the sample causes a slight increase in the induced current in this coil thus upsetting the balance in the signal generated from the sensing coil. This produces an output of a difference to the difference amplifier (see generally col. 6, line 36 – col. 7, line 24). The sample then moves from the first to the second coil causing a similar unbalanced increase in the induced current in the second coil, but because this coil is wound in the opposite direction to the first, the current flows in the opposite direction through the coils resulting in the phase of the coil output being reversed 180° as shown in Fig. 6 (col. 7, lines 2-4). Simmonds teaches that this effect provides a very powerful detection technique (col. 7, lines 4-5).

The output signal amplitude is modulated by moving the sample with respect to the array of sensing coils. As such, it would have been understood by one of ordinary skill in the art that the movement of the sample past the coils must be carefully controlled because there is a response in the output from the difference amplifier consisting of an AC signal with a frequency equal to that of the magnetic driver circuitry. The amplitude of the AC signal difference first increases in magnitude from zero to a maximum value as the sample passes the first coil. Then, after returning to zero, the amplitude reaches a second maximum as the

sample passes the second coil, but the two responses differ in phase by 180°. The output signal amplitude is modulated by moving the sample with respect to the array of the sensing coil thus permitting rejection of signals due solely to system and external inputs and not due to the presence of a sample itself (col. 7, lines 15-18). The digitized shape of the signal amplitude with respect to the sample position is compared to a theoretical response shape stored in PC 66 using appropriate conventional curve fitting techniques, resulting in what Simmonds describes as a very accurate estimate of the magnetic content of the sample excluding inherent instrument noise and drift (col. 7, lines 18-24).

Claim 9 recites, among other features, determining the number of magnetic particles bound to the substrate by determining the difference in <u>the resonant frequency of a tuned circuit</u> when the substrate is exposed to a magnetic field generated by <u>a coil</u> ... wherein the tuned circuit is connected to a phase locked loop comprising a driver which generates a driving signal for driving the tuned circuit, and a phase comparator for determining the phase difference between the driving signal and an output signal obtained from the tuned circuit, the difference in resonant frequency being determined by monitoring the performance of the phase locked loop.

Applicants respectfully submit that Simmonds does not disclose a phase locked loop, nor is such a feature called out in the Office Action. Reference to the phase sensitive detector (element 62 of Fig. 4 of Simmonds) does not equate to the phase locked loop of claim 1. Specifically, the phase sensitive detector is used solely as a part of the circuitry to demodulate the signal from the difference amplifier. There is neither depicted nor described any feedback to the drive circuitry which produces the driving signal. A phase locked loop circuit, which is affirmatively recited in independent claim 9, is useful in, for example, providing an error signal that is fed back to the driver in order to attempt to ensure that the tuned circuit is always operating at the resonant frequency.

Applicants respectfully submit that, despite an apparent attempt in the Office Action at the bottom of page 2 and the top of page 3, to assert that measuring differences in amplitude is equivalent to measuring differences in resonant frequencies, measuring accumulation of magnetic particles by means of AC magnetic excitation and inductive sensing of the amplitude of the resulting oscillation of the magnetic moment of the particles at the excitation frequency is not the same as determining the difference in the resonant frequency of a tuned circuit. Simmonds stabilizes the excitation field inducing the signal in the coil at a fixed frequency. This is not the same frequency as the varying self-resonant frequency of the sensing coil with and without magnetic particles present. Applicants further respectfully submit that there is nothing in Simmonds to suggest that monitoring frequency change of a tuned circuit is an appropriate or even possible methodology for magnetic particle detection.

Applicants further respectfully submit that two identical sensing coils wound in opposite directions that form the gradiometer of the Simmonds device are essential to its operation, otherwise the balanced coil arrangement upon which that invention relies would not be possible, nor would it be possible to produce the response curve shown, for example, in Fig. 6 of that patent. In contrast, in the subject matter recited in claim 9, with reference to Figs. 7, 9, 11a and 11b, a single coil tuned circuit in which a single sensing coil acts as the inductance measuring member is sufficient. This is an advantage over the Simmonds device.

For at least these reasons, Applicants respectfully submit that Simmonds cannot reasonably be read to anticipate all of the features recited in at least independent claim 9. Additionally, Applicants respectfully submit that the subject matter recited in claims 10-13 is also not anticipated, nor would it even have been suggested, by Simmonds for at least the respective dependence of these claims on independent claim 9.

For at least these reasons, Applicants respectfully submit that the subject matter of claims 9-13 is not anticipated nor rendered obvious by the disclosure of Simmonds. Accordingly, reconsideration and withdrawal of the rejection of claims 9-13 under 35 U.S.C. §102(b) as being anticipated by Simmonds are respectfully requested.

In view of the foregoing, Applicants respectfully submit that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 9-13 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number set forth below.

Respectfully submitted,

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